| | | |
|---|---|---|
| PREPARED BY : DATE | SHARP | SPEC No. LD-K23628 |
| APPROVED BY : DATE | | FILE No. |
| | | ISSUE: JUNE, 28, 2011 |
| | LIQUID CRYSTAL DISPLAY GROUP<br>SHARP CORPORATION<br>SPECIFICATION | APPLICABLE GROUP<br>LARGE LIQUID CRYSTAL<br>DISPLAY BUSINESS GROUP |

# DEVICE SPECIFICATION FOR

# TFT-LCD Open-Cell

# MODEL No. LK600D3HA10

CUSTOMERS APPROVAL

DATE _____

BY _____

BY M. Bando

M. Bandoh

DEPARTMENT GENERAL MANAGER

DEVELOPMENT DEPARTMENT III

LIQUID CRYSTAL DISPLAY DIVISION

LARGE LIQUID CRYSTAL DISPLAY BUSINESS GROUP

SHARP CORPORATION

# RECORDS OF REVISION

Model: LK600D3HA10

| SPEC No. | DATE | REVISED No. | PAGE | SUMMARY | NOTE |
|---|---|---|---|---|---|
| LD- K23628 | 2011.6.28 | - | - | - | 1st ISSUE |

## 1. Application

This specification is applied to the color 60.0" TFT-LCD Open Cell LK600D3HA10.

* This specification is proprietary products of SHARP CORPORATION ("SHARP") and includes materials protected under copyright of SHARP. Do not reproduce or cause any third party to reproduce them in any form or by any means, electronic or mechanical, for any purpose, in whole or in part, without the express written permission of SHARP.

* In case of using the device for applications such as control and safety equipment for transportation (aircraft, trains, automobiles, etc.), rescue and security equipment and various safety related equipment which require higher reliability and safety, take into consideration that appropriate measures such as fail-safe functions and redundant system design should be taken.

* Do not use the device for equipment that requires an extreme level of reliability, such as aerospace applications, telecommunication equipment (trunk lines), nuclear power control equipment and medical or other equipment for life support.

* SHARP assumes no responsibility for any damage resulting from the use of the device that does not comply with the instructions and the precautions specified in these technical literature.

* Contact and consult with a SHARP sales representative for any questions about this device.

## 2. Overview

This Open Cell is color active matrix LCD Open Cell incorporating amorphous silicon TFT (Thin Film Transistor). It is composed of a color TFT-LCD panel, driver ICs and Source PWB.

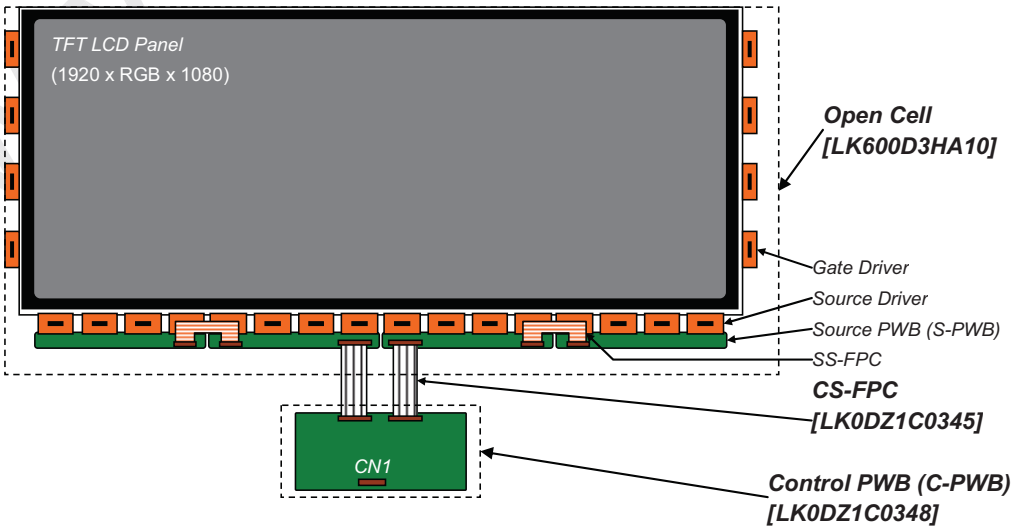
The following contents can be achieved in using LK0DZ1C0348 (C-PWB) and LK0DZ1C0345 (CS-FPC) that SHARP specifies.

Graphics and texts can be displayed on a 1920 x RGB x 1080 dots panel with one billion colors by using 10bit LVDS (Low Voltage Differential Signaling) to interface, +12V of DC supply voltages.

And in order to improve the response time of LCD, this module applies the Over Shoot driving (O/S driving) technology for the control circuit. In the O/S driving technology, signals are being applied to the Liquid Crystal according to a pre-fixed process as an image signal of the present frame when a difference is found between image signal of the previous frame and that of the current frame after comparing them.

This Open Cell also adopts Double Frame Rate driving method including FRC (Frame Rate Control) function on the control circuit. Therefore the input signal to this Open Cell is Single Frame Rate, but the output is Double-Frame Rate picture(inserting the intermediate image which is generated by the FRC).

With combination of these technologies, motion blur can be reduced and clearer display performance can be realized.



## 3. Mechanical Specifications

| Parameter | Specifications | Unit |
|---|---|---|
| Display size | 152.496 (Diagonal) | cm |
| | 60.0 (Diagonal) | inch |
| Active area | 1329.12 (H) x 747.63 (V) | mm |
| Pixel Format | 1920 (H) x 1080 (V)<br>(1pixel = R + G + B dot) | pixel |
| Pixel pitch | 0.69225 (H) x 0.69225 (V) | mm |
| Pixel configuration | R, G, B vertical stripe | |
| Display mode | Normally black | |
| Open Cell Outline Dimensions [Note1] | 1364.18(H) x 806.05(V) x 3.5(D) | mm |
| Mass | 4.2 ± 0.3 | kg |
| Surface treatment [Note2] | - Front polarizer : Anti glare<br>Hard coating: 2H and more<br>- Rear polarizer :<br>Hard coating less | |

[Note1] Outline dimensions are shown in P20.
The thickest point is 80pin CN of S-PWB.
[Note2] With the protection film removed.

## 4. Open Cell Driving Specifications

### 4.1. Driving interface of C-PWB SHARP specifies [LK0DZ1C0348]

CN1 (Interface signals and +12V DC power supply)

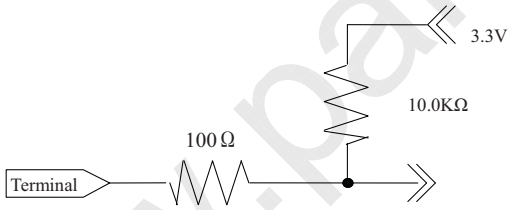
Using connector : FI-RE51S-HF, or FI-REN51S2-HF (Japan Aviation Electronics Ind., Ltd.)
Mating connector : FI-RE51HL, FI-RE51CL (Japan Aviation Electronics Ind., Ltd.)
Mating LVDS transmitter : THC63LVD1023 or equivalent device

| Pin No. | Symbol | Function | Remark |
|---|---|---|---|
| 1 | GND | | |
| 2 | I2C_SDA | I2C data signal [Note 2] | Pull up 3.3V |
| 3 | I2C_SCL | I2C clock signal [Note 2] | Pull up 3.3V |
| 4 | Reserved | It is required to set non-connection(OPEN) | |
| 5 | Reserved | It is required to set non-connection(OPEN) | |
| 6 | Reserved | It is required to set non-connection(OPEN) | |
| 7 | SELLVDS | Select LVDS data order [Note 3] | Pull up 3.3V [Note 1] |
| 8 | Reserved | It is required to set non-connection(OPEN) | |
| 9 | Reserved | It is required to set non-connection(OPEN) | |
| 10 | Reserved | It is required to set non-connection(OPEN) | |
| 11 | GND | | |
| 12 | AIN0- | Aport (-)LVDS CH0 differential data input | |
| 13 | AIN0+ | Aport (+)LVDS CH0 differential data input | |
| 14 | AIN1- | Aport (-)LVDS CH1 differential data input | |
| 15 | AIN1+ | Aport (+)LVDS CH1 differential data input | |
| 16 | AIN2- | Aport (-)LVDS CH2 differential data input | |
| 17 | AIN2+ | Aport (+)LVDS CH2 differential data input | |
| 18 | GND | | |
| 19 | ACK- | Aport LVDS Clock signal(-) | |
| 20 | ACK+ | Aport LVDS Clock signal(+) | |
| 21 | GND | | |
| 22 | AIN3- | Aport (-)LVDS CH3 differential data input | |
| 23 | AIN3+ | Aport (+)LVDS CH3 differential data input | |
| 24 | AIN4- | Aport (-)LVDS CH4 differential data input | |

| | | | |
|---|---|---|---|
| 25 | AIN4+ | Aport (+)LVDS CH4 differential data input | |
| 26 | GND | | |
| 27 | GND | | |
| 28 | BIN0- | Bport (-)LVDS CH0 differential data input | |
| 29 | BIN0+ | Bport (+)LVDS CH0 differential data input | |
| 30 | BIN1- | Bport (-)LVDS CH1 differential data input | |
| 31 | BIN1+ | Bport (+)LVDS CH1 differential data input | |
| 32 | BIN2- | Bport (-)LVDS CH2 differential data input | |
| 33 | BIN2+ | Bport (+)LVDS CH2 differential data input | |
| 34 | GND | | |
| 35 | BCK- | Bport LVDS Clock signal(-) | |
| 36 | BCK+ | Bport LVDS Clock signal(+) | |
| 37 | GND | | |
| 38 | BIN3- | Bport (-)LVDS CH3 differential data input | |
| 39 | BIN3+ | Bport (+)LVDS CH3 differential data input | |
| 40 | BIN4- | Bport (-)LVDS CH4 differential data input | |
| 41 | BIN4+ | Bport (+)LVDS CH4 differential data input | |
| 42 | GND | | |
| 43 | GND | | |
| 44 | GND | | |
| 45 | GND | | |
| 46 | GND | | |
| 47 | VCC | +12V Power Supply | |
| 48 | VCC | +12V Power Supply | |
| 49 | VCC | +12V Power Supply | |
| 50 | VCC | +12V Power Supply | |
| 51 | VCC | +12V Power Supply | |

[Note] GND of a liquid crystal panel drive part should be connected with a module chassis.

[Note1] The equivalent circuit figure of the terminal




[Note 2] The equivalent circuit figure of the terminal for I2C control

Please refrain from the use of the device that the slave address overlaps.

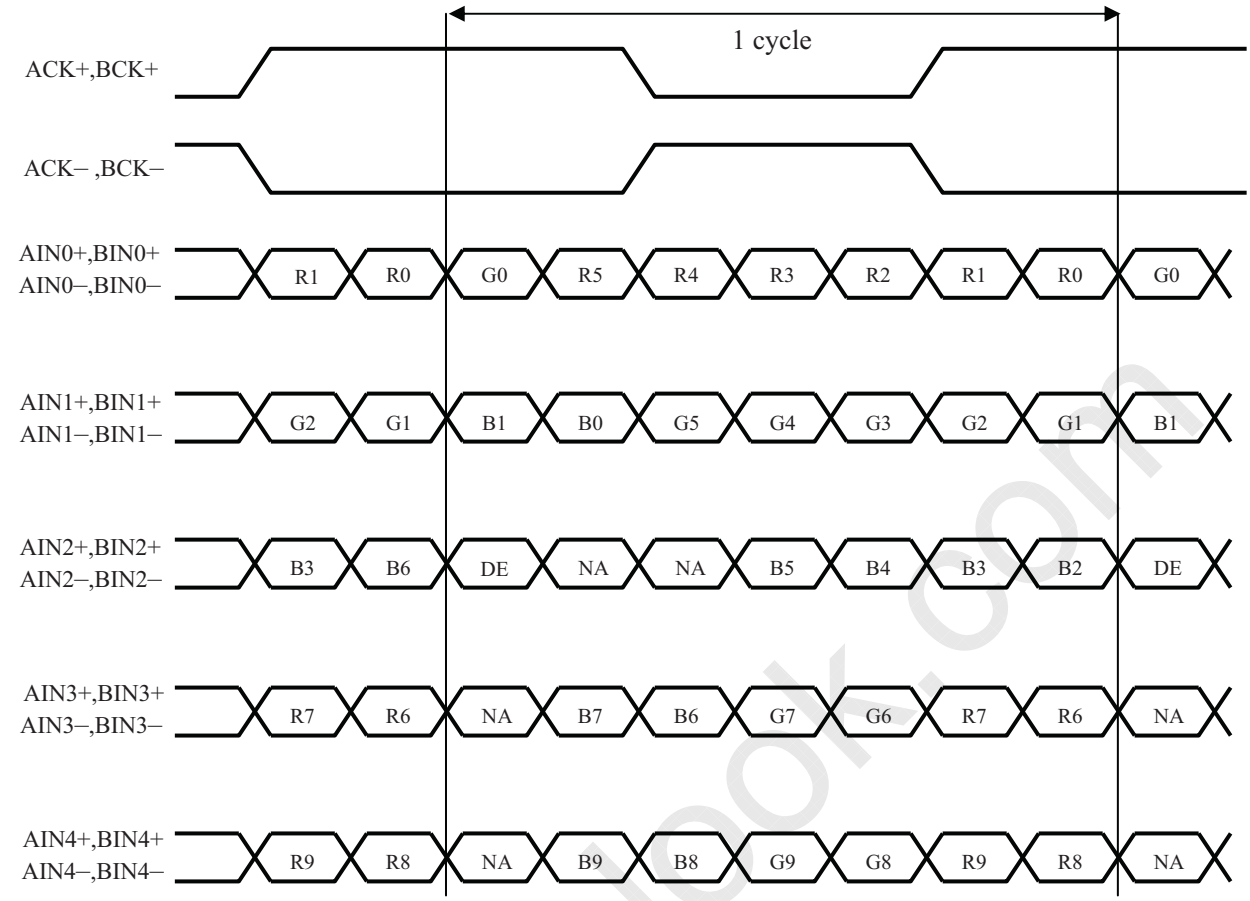
Slave address used for this LCD module: B4, B5, D4, D5, 9E, 9F .

[Note 3] LVDS Data order

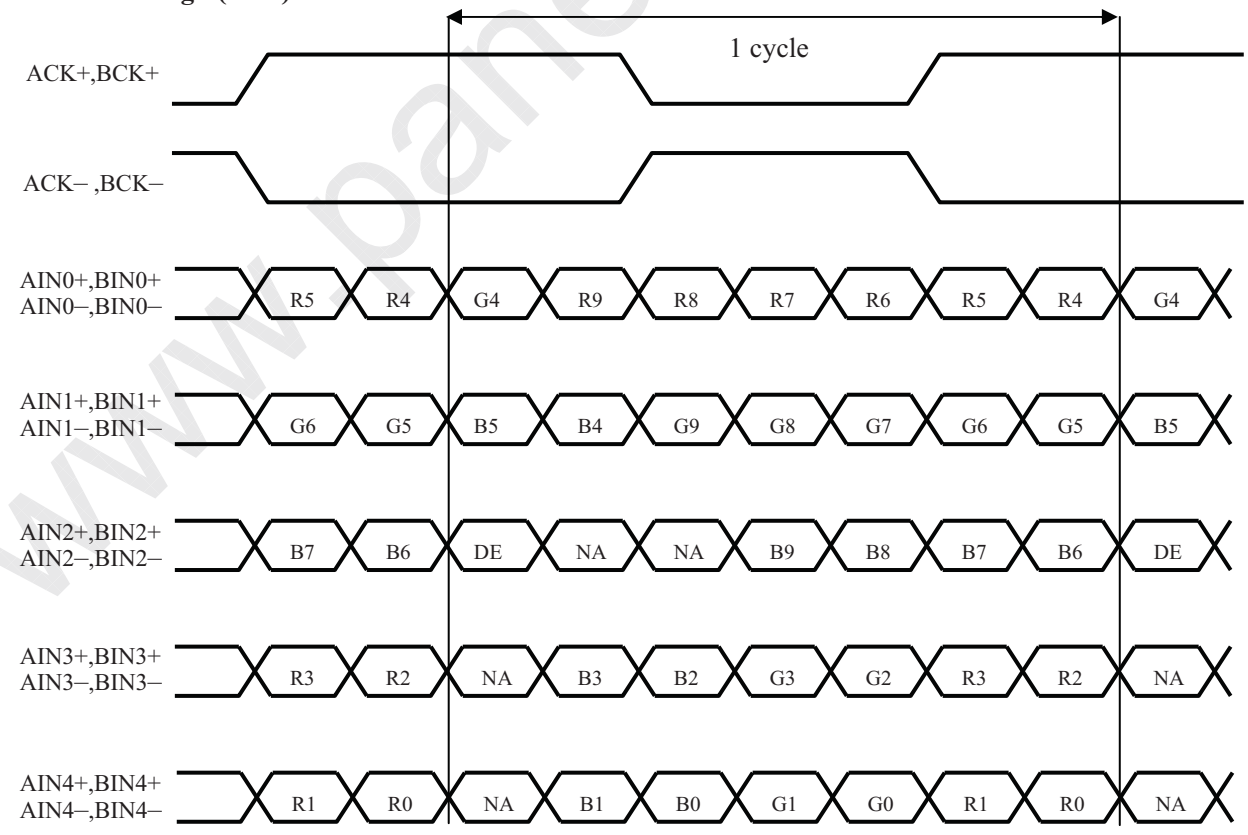
| SELLVDS | | |
|---|---|---|
| Data | L(GND) [VESA] | H(3.3V) or Open [JEIDA] |
| TA0 | R0(LSB) | R4 |
| TA1 | R1 | R5 |
| TA2 | R2 | R6 |
| TA3 | R3 | R7 |
| TA4 | R4 | R8 |
| TA5 | R5 | R9(MSB) |
| TA6 | G0(LSB) | G4 |
| TB0 | G1 | G5 |
| TB1 | G2 | G6 |
| TB2 | G3 | G7 |
| TB3 | G4 | G8 |
| TB4 | G5 | G9(MSB) |
| TB5 | B0(LSB) | B4 |
| TB6 | B1 | B5 |
| TC0 | B2 | B6 |
| TC1 | B3 | B7 |
| TC2 | B4 | B8 |
| TC3 | B5 | B9(MSB) |
| TC4 | NA | NA |
| TC5 | NA | NA |
| TC6 | DE(*) | DE(*) |
| TD0 | R6 | R2 |
| TD1 | R7 | R3 |
| TD2 | G6 | G2 |
| TD3 | G7 | G3 |
| TD4 | B6 | B2 |
| TD5 | B7 | B3 |
| TD6 | N/A | N/A |
| TE0 | R8 | R0(LSB) |
| TE1 | R9(MSB) | R1 |
| TE2 | G8 | G0(LSB) |
| TE3 | G9(MSB) | G1 |
| TE4 | B8 | B0(LSB) |
| TE5 | B9(MSB) | B1 |
| TE6 | N/A | N/A |

NA: Not Available
(*)Since the display position is prescribed by the rise of DE(Display Enable)signal, please do not fix DE signal during operation at ”High”.

**SELLVDS= Low (GND)**

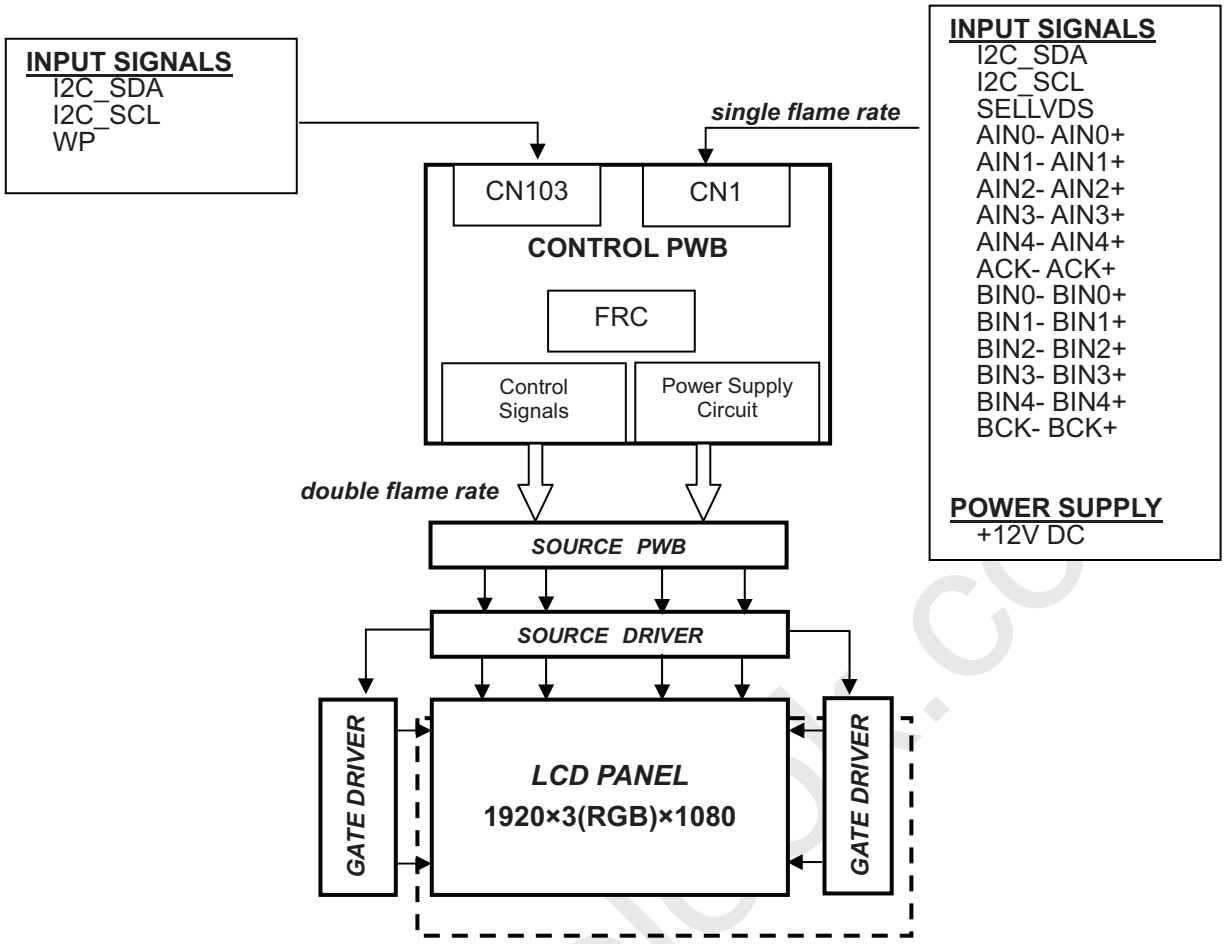



**SELLVDS= High (3.3V) or OPEN**




DE: Display Enable, NA: Not Available (Fixed Low)

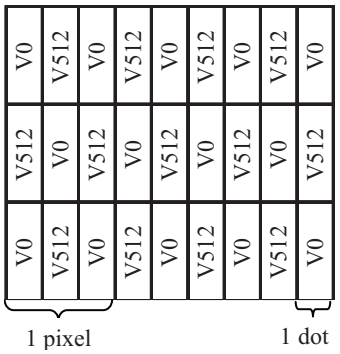
## 4.2. Interface block diagram



### 4.3. Vcom adjustment interface of Control PWB SHARP specifies. [LK0DZ1C0348]

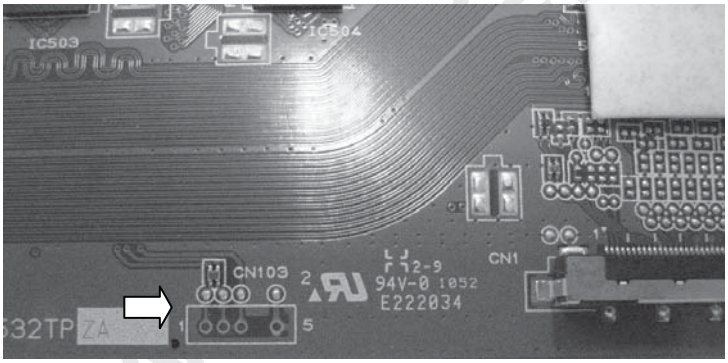
For the prevention of long-time image sticking of TFT-LCD panel, be sure to adjust Vcom in such as a way that flicker is minimum on the center of display by flicker meter.

[Note 1] Adjust VCOM voltage at below pattern:




[Note 2] VCOM voltage can be adjusted through via holes (CN103).
Potentiometer IC and via holes are as follows:

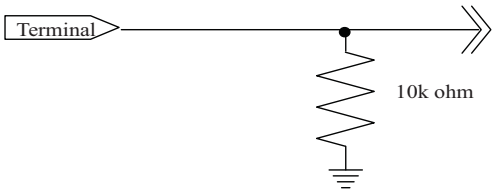
IC for adjusting VCOM : ISL45041 (Intersil)
Using Via Hole : 1.5mm Pitch (φ0.7mm )
Mating connector : (housing) 5P-SZN,
(contact) SZN-002T-P0.7K (JST Co.,Ltd.)
Communication method : I2C




| Pin No. | symbol | Function | Remark |
|---|---|---|---|
| 1 | I2C_SDA | I2C DATA | Pull up:3.3V[Note3] |
| 2 | I2C_SCL | I2C CLK | Pull up:3.3V[Note3] |
| 3 | WP | L:disable, H:enable | Pull down [Note4] |
| 4 | NC | No via hole | |
| 5 | GND | | |

[Note3] The equivalent circuit figure of the terminal


[Note4] The equivalent circuit figure of the terminal




## 5. Absolute maximum ratings

| Parameter | Symbol | Condition | Ratings | Unit | Remark |
|---|---|---|---|---|---|
| Input voltage (for Control) | $V_I$ | Ta=25 °C | -0.3 ~ 3.6 | V | [Note 1] |
| 12V supply voltage (for Control) | VCC | Ta=25 °C | 0 ~ + 14 | V | |
| Storage temperature | Tstg | - | -25 ~ +60 | °C | [Note 2] |
| Operation temperature (Ambient) | Topa | - | 0 ~ +50 | °C | |

[Note 1] I2C_SDA、I2C_SCL、SELLVDS、WP

[Note 2] Humidity 95%RH Max.(Ta≦40°C)

Maximum wet-bulb temperature at 39 °C or less.(Ta>40°C)

No condensation.

## 6. Electrical characteristics of input signals

### 6.1. Control circuit driving

Ta=25 °C

| Parameter | | Symbol | Min. | Typ. | Max. | Uniit | Remark |
|---|---|---|---|---|---|---|---|
| +12V supply voltage | Supply voltage | Vcc | 11.4 | 12 | 12.6 | V | [Note 1] |
| | Current dissipation | Icc | - | 1.4 | 3.5 | A | [Note 2] |
| | Inrush current | $I_{RUSH}1$ | - | 8.2 | - | A | t1=500us [Note 7] |
| | | $I_{RUSH}2$ | - | 1.2 | - | A | t1>5ms |
| Permissible input ripple voltage | | $V_{RP}$ | - | - | 100 | $mV_{P-P}$ | Vcc = +12.0V |
| Input Low voltage | | $V_{IL}$ | 0 | - | 1.0 | V | [Note 3] |
| Input High voltage | | $V_{IH}$ | 2.3 | - | 3.3 | V | |
| Input leak current (Low) | | $I_{IL1}$ | - | - | 400 | μA | $V_I$ = 0V [Note 5] |
| | | $I_{IL2}$ | - | - | 100 | μA | $V_I$ = 0V [Note 4] |
| Input leak current (High) | | $I_{IH1}$ | - | - | 100 | μA | $V_I$ = 3.3V [Note 5] |
| | | $I_{IH2}$ | - | - | 400 | μA | $V_I$ = 3.3V [Note 4] |
| Terminal resistor | | $R_T$ | - | 100 | - | Ω | Differential input |
| Input Differential voltage | | \|VID\| | 200 | 400 | 600 | mV | [Note 6] |
| Differential input common mode voltage | | VCM | \|VID\|/2 | 1.2 | 2.4-\|VID\|/2 | V | [Note 6] |

[Note]$V_{CM}$: Common mode voltage of LVDS driver.

[Note 1]

Input voltage sequences

50 μ s < t1 ≦ 20ms

20ms < t2 ≦ 50ms

20ms < t3 ≦ 50ms

0 < t4 ≦ 1s

t5 ≧ 950ms

t6 ≧ 0

t7 ≧ 300ms

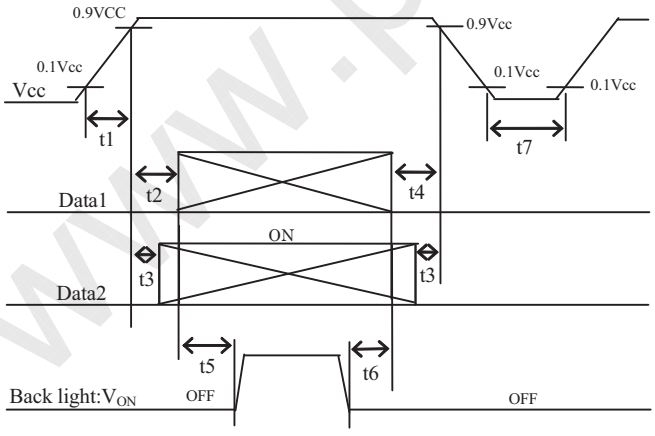
Dip conditions for supply voltage

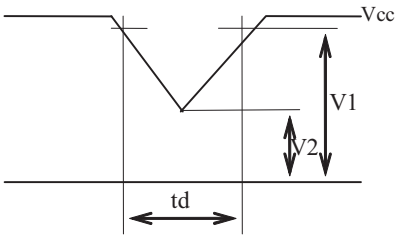
a) $V_2$ ≦ Vcc < $V_1$

td ≦ 10ms

b) Vcc < $V_2$

Dip conditions for supply voltage is based on input voltage sequence.




V1:10.8V
V2:9.1V

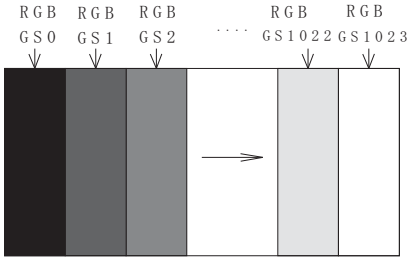
※ Data1: ACK±, AIN0±, AIN1±, AIN2±, AIN3±, AIN4±,BCK±, BIN0±, BIN1±, BIN2±, BIN3±, BIN4±

*$V_{CM}$ voltage pursues the sequence mentioned above

※ Data2: I2C_SDA 、I2C_SCL、SELLVDS、WP

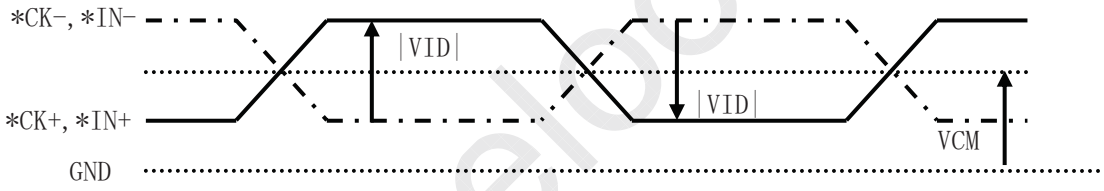
[Note]About the relation between data input and back light lighting, please base on the above-mentioned input sequence. When back light is switched on before panel operation or after a panel operation stop, it may not display normally. But this phenomenon is not based on change of an incoming signal, and does not give damage to a liquid crystal display.

[Note 2] Typical current situation: 1024 gray-bar patterns. (Vcc = +12.0V)
The explanation of RGB gray scale is seen in section 8.

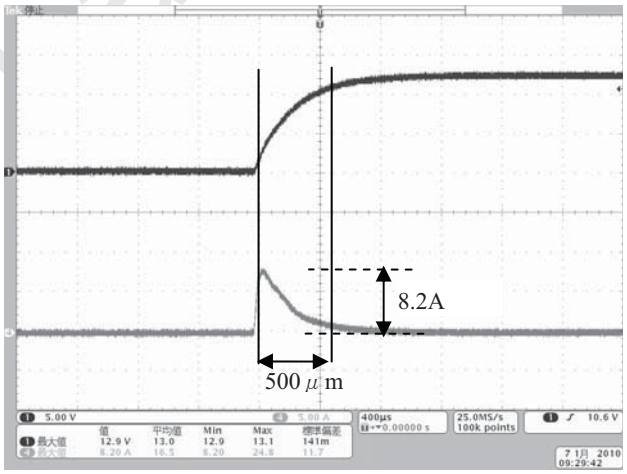



Vcc＝+12.0V
CK＝74.25MHz
Th＝14.8μs

[Note 3] I2C_SDA 、I2C_SCL、SELLVDS、WP
[Note 4] I2C_SDA 、I2C_SCL、SELLVDS
[Note 5] WP
[Note 6] ACK±, AIN0±, AIN1±, AIN2±, AIN3±, AIN4±,BCK±, BIN0±, BIN1±, BIN2±, BIN3±, BIN4±




[Note 7] Vcc12V inrush current waveform




Vcc

Irush

## 7. Timing characteristics of input signals

### 7.1. Timing characteristics

Timing diagrams of input signal are shown in Fig.2.

| Parameter | | Symbol | Min. | Typ. | Max. | Unit | Remark |
|---|---|---|---|---|---|---|---|
| Clock | Frequency | 1/Tc | 67 | 74.25 | 76 | MHz | |
| Data enable signal | Horizontal period | TH | 1050 | 1100 | 1300 | clock | |
| | | | 14.2 | 14.8 | 16.1 | µs | |
| | Horizontal period (High) | THd | 960 | 960 | 960 | clock | |
| | Vertical period | TV | 1109 | 1125 | 1400 | line | |
| | | | 47 | 60 | 61 | Hz | |
| | Vertical period (High) | TVd | 1080 | 1080 | 1080 | line | |

[Note]-When vertical period is very long, flicker and etc. may occur.

-Please turn off the module after it shows the black screen.

-Please make sure that length of vertical period should become of an integral multiple of horizontal length of period. Otherwise, the screen may not display properly.

-As for your final setting of driving timing, we will conduct operation check test at our side, please inform your final setting.

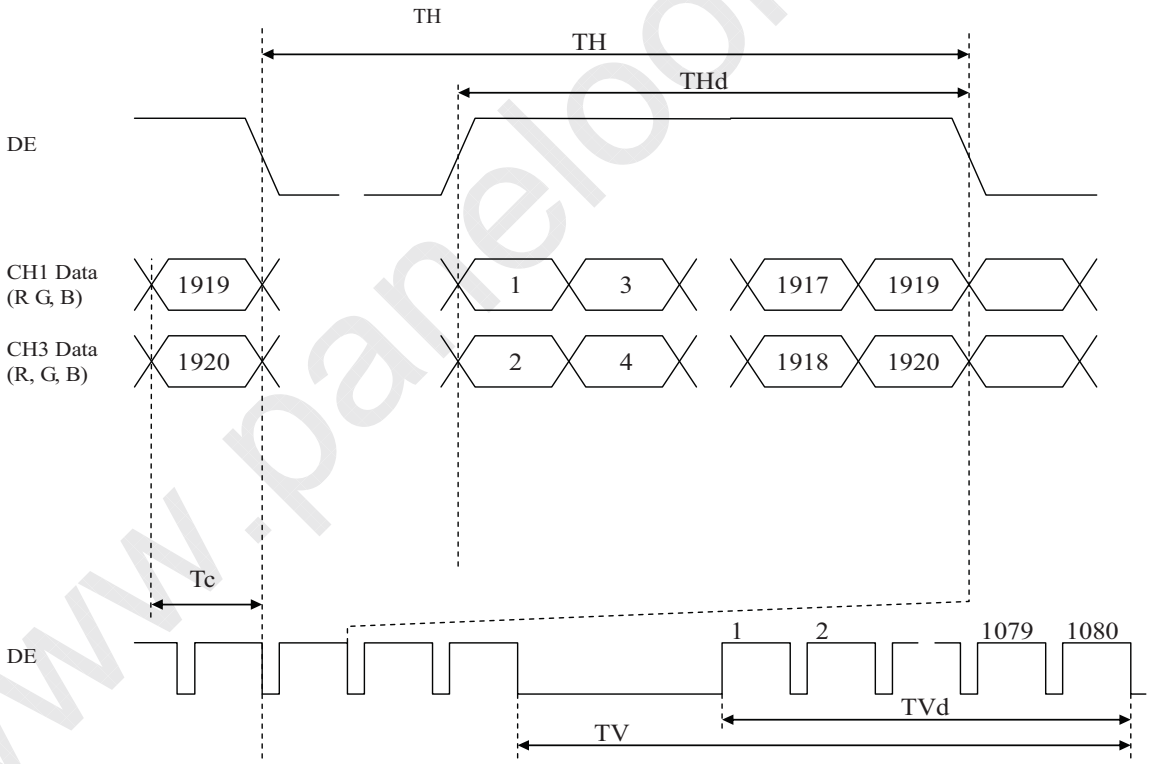
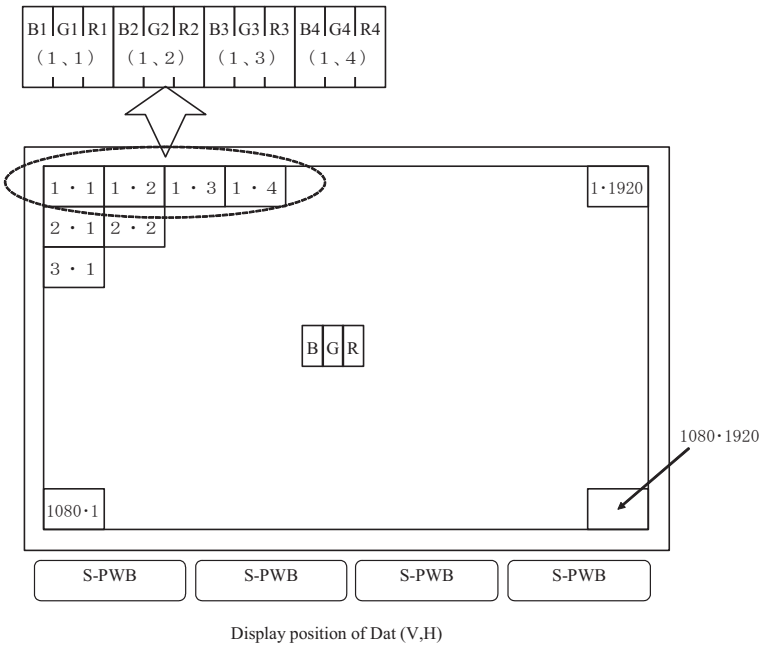



Fig2 Timing diagram of input signal

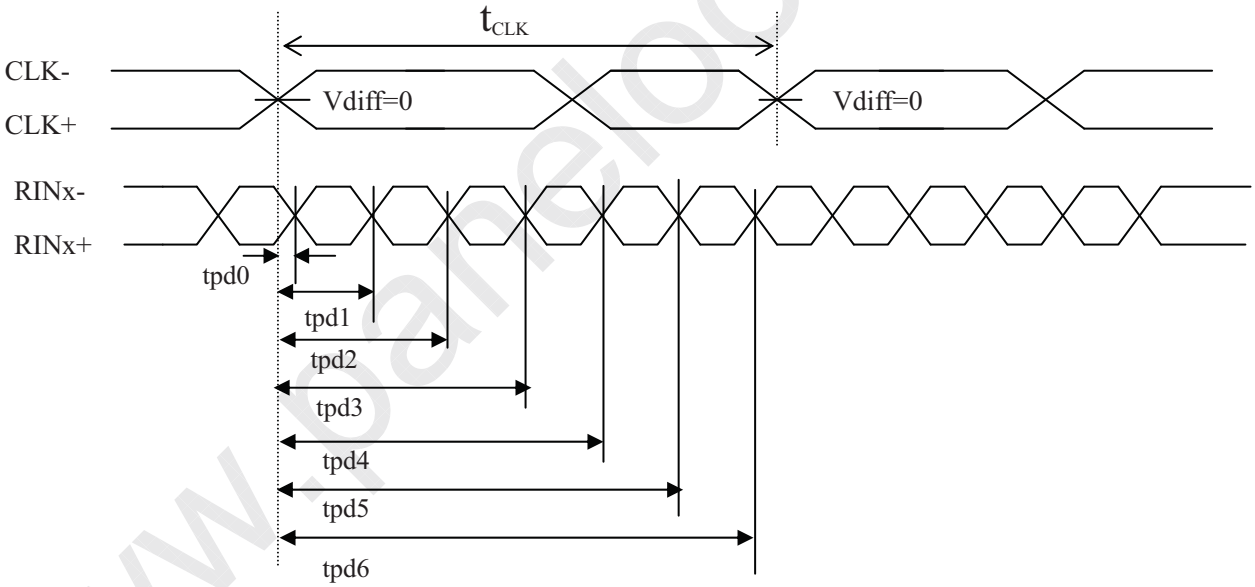
7.2. Input data signal and display position on the screen




Display position of Dat (V,H)

[Note] Scan direction is setting for using S-PWBs' side down.

7-3. LVDS signal characteristics




| The item | | Symbol | min. | typ. | max. | unit |
|---|---|---|---|---|---|---|
| Data position | Delay time, CLK rising edge to serial bit position 0 | tpd0 | -0.25 | 0 | 0.25 | ns |
| | Delay time, CLK rising edge to serial bit position 1 | tpd1 | 1*$t_{CLK}$/7-0.25 | 1* $t_{CLK}$ /7 | 1* $t_{CLK}$ /7+0.25 | |
| | Delay time, CLK rising edge to serial bit position 2 | tpd2 | 2* $t_{CLK}$ /7-0.25 | 2* $t_{CLK}$ /7 | 2* $t_{CLK}$ /7+0.25 | |
| | Delay time, CLK rising edge to serial bit position 3 | tpd3 | 3* $t_{CLK}$ /7-0.25 | 3* $t_{CLK}$ /7 | 3* $t_{CLK}$ /7+0.25 | |
| | Delay time, CLK rising edge to serial bit position 4 | tpd4 | 4* $t_{CLK}$ /7-0.25 | 4* $t_{CLK}$ /7 | 4* $t_{CLK}$ /7+0.25 | |
| | Delay time, CLK rising edge to serial bit position 5 | tpd5 | 5* $t_{CLK}$ /7-0.25 | 5* $t_{CLK}$ /7 | 5* $t_{CLK}$ /7+0.25 | |
| | Delay time, CLK rising edge to serial bit position 6 | tpd6 | 6* $t_{CLK}$ 7-0.25 | 6* $t_{CLK}$ /7 | 6* $t_{CLK}$ /7+0.25 | |

## 8. Input Signal, Basic Display Colors and Gray Scale of Each Color

| | Colors & Gray scale | Gray Scale | Data signal | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | R0 | R1 | R2 | R3 | R4 | R5 | R6 | R7 | R8 | R9 | G0 | G1 | G2 | G3 | G4 | G5 | G6 | G7 | G8 | G9 | B0 | B1 | B2 | B3 | B | B5 | B6 | B7 | B8 | B9 |
| Basic Color | Black | – | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blue | – | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Green | – | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Cyan | – | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Red | – | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Magenta | – | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Yellow | – | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | White | – | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Gray Scale of Red | Black | GS0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ⇧ | GS1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Darker | GS2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ⇧ | ↓ | | | | | ↓ | | | | | | | | | | ↓ | | | | | | | | | | ↓ | | | | | |
| | ⇩ | ↓ | | | | | ↓ | | | | | | | | | | ↓ | | | | | | | | | | ↓ | | | | | |
| | Brighter | GS1021 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ⇩ | GS1022 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red | GS1023 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gray Scale of Green | Black | GS0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ⇧ | GS1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Darker | GS2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ⇧ | ↓ | | | | | ↓ | | | | | | | | | | ↓ | | | | | | | | | | ↓ | | | | | |
| | ⇩ | ↓ | | | | | ↓ | | | | | | | | | | ↓ | | | | | | | | | | ↓ | | | | | |
| | Brighter | GS1021 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ⇩ | GS1022 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green | GS1023 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Gray Scale of Blue | Black | GS0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ⇧ | GS1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Darker | GS2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | ⇧ | ↓ | | | | | ↓ | | | | | | | | | | ↓ | | | | | | | | | | ↓ | | | | | |
| | ⇩ | ↓ | | | | | ↓ | | | | | | | | | | ↓ | | | | | | | | | | ↓ | | | | | |
| | Brighter | GS1021 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | ⇩ | GS1022 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Blue | GS1023 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

0: Low level voltage, 1: High level voltage.

Each basic color can be displayed in 1021 gray scales from 10 bits data signals. According to the combination of total 30 bits data signals, one billion-color display can be achieved on the screen.

## 9. Optical characteristics

Ta=25°C, Vcc=12.0V, Timing:60Hz(typ. value)

| Parameter | | Symbol | Condition | Min. | Typ. | Max. | Unit | Remark |
|---|---|---|---|---|---|---|---|---|
| Viewing angle range | Horizontal | $\theta$21<br>$\theta$22 | CR≧10 | 70 | 88 | - | Deg. | [Note1,4] |
| | Vertical | $\theta$11<br>$\theta$12 | | 70 | 88 | - | Deg. | |
| Contrast ratio | | CRn | $\theta$=0 deg. | 3,500 | 5,000 | - | - | [Note2,4] |
| Response time | | $\tau_{DRV}$ | | | 4 | | ms | [Note3,4,5] |
| Luminance | White | x | | Typ.-0.03 | 0.280 | Typ.+0.03 | - | [Note4] |
| | | y | | Typ.-0.03 | 0.285 | Typ.+0.03 | - | |
| | Red | x | | Typ.-0.03 | 0.646 | Typ.+0.03 | - | |
| | | y | | Typ.-0.03 | 0.337 | Typ.+0.03 | - | |
| | Green | x | | Typ.-0.03 | 0.281 | Typ.+0.03 | - | |
| | | y | | Typ.-0.03 | 0.607 | Typ.+0.03 | - | |
| | Blue | x | | Typ.-0.03 | 0.143 | Typ.+0.03 | - | |
| | | y | | Typ.-0.03 | 0.071 | Typ.+0.03 | - | |
| Luminance | White | $Y_L$ | | 400 | 500 | - | cd/m$^2$ | |
| Luminance uniformity | White | $\delta$w | | | | 1.25 | | [Note 6] |

Optical characteristics are based on SHARP standard module LK600D3LA38.

*The measurement shall be executed 60 minutes after lighting at rating.

[Note]The optical characteristics are measured using the following equipment.

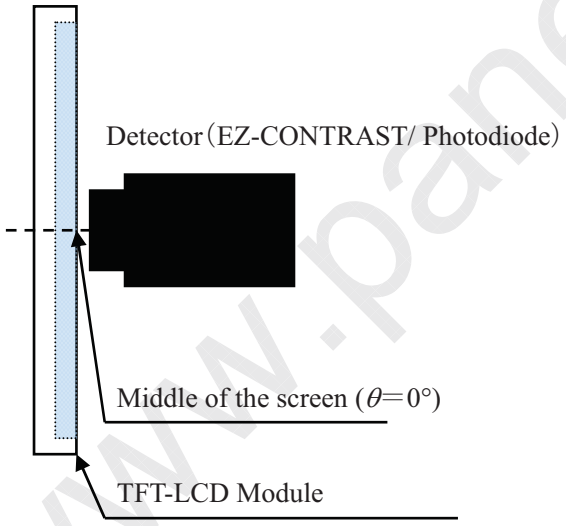



Fig.4-1 Measurement of viewing angle range and Response time.
Viewing angle range: EZ-CONTRAST
Response time: Photodiode

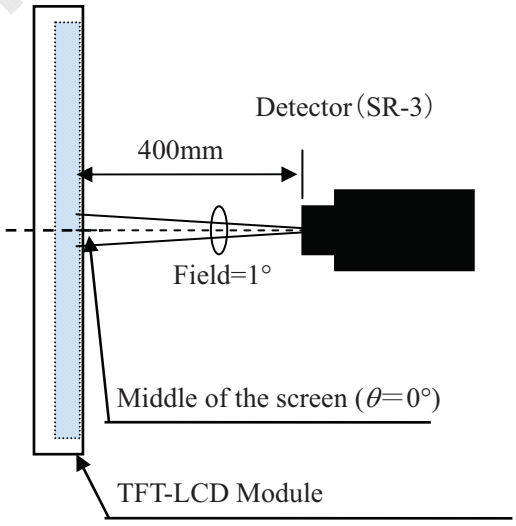
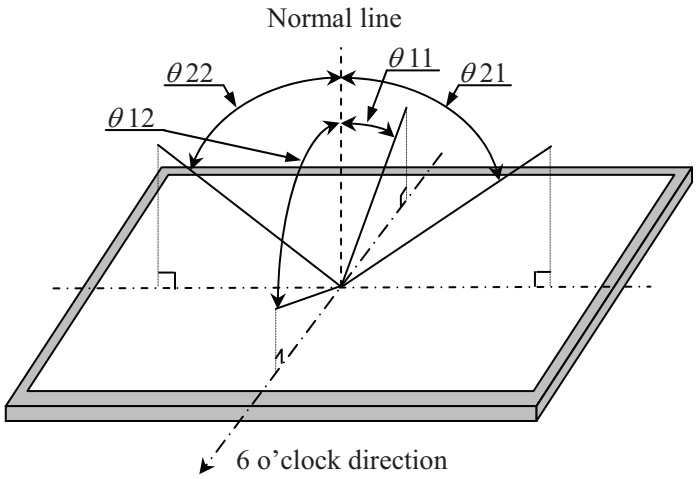



Fig.4-2 Measurement of Contrast, Luminance, Chromaticity.

[Note 1]Definitions of viewing angle range :




[Note 2]Definition of contrast ratio :

The contrast ratio is defined as the following.

$$\text{Contrast Ratio} = \frac{\text{Luminance (brightness) with all pixels white}}{\text{Luminance (brightness) with all pixels black}}$$

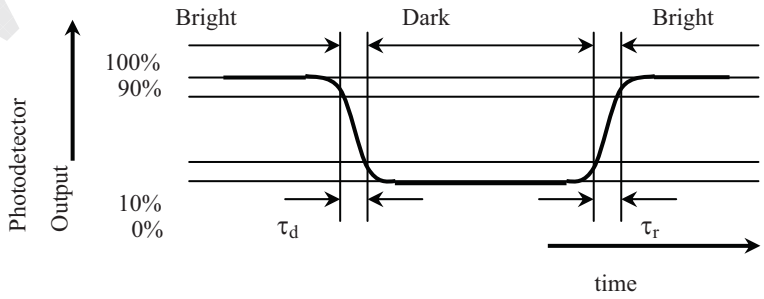
[Note 3]Definition of response time

The response time ($\tau_d$ and $\tau_r$) is defined as the following figure and shall be measured by switching the input signal for "any level of gray (0%, 25%, 50%, 75% and 100%)" and "any level of gray (0%, 25%, 50%, 75% and 100%)".

| | 0% | 25% | 50% | 75% | 100% |
|---|---|---|---|---|---|
| 0% | | tr:0%-25% | tr:0%-50% | tr:0%-75% | tr:0%-100% |
| 25% | td: 25%-0% | | tr: 25%-50% | tr25%-75% | tr: 25%-100% |
| 50% | td: 50%-0% | td: 50%-25% | | tr: 50%-75% | tr: 50%-100% |
| 75% | td: 75%-0% | td: 75%-25% | td: 75%-50% | | tr: 75%-100% |
| 100% | td: 100%-0% | td: 100%-25% | td: 100%-50% | td:100%-75% | |

t*:x-y...response time from level of gray(x) to level of gray(y)

$\tau_r = \Sigma(tr:x\text{-}y)/10$ , $\tau_d = \Sigma(td:x\text{-}y)/10$



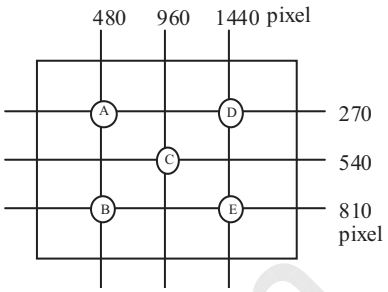

[Note 4]This shall be measured at center of the screen.

[Note 5] This value is valid when O/S driving is used at typical input time value.

[Note 6]Definition of white uniformity ;

White uniformity is defined as the following with five measurements. (A~E)

$$\delta W = \frac{\text{Maximum luminance of five points (brightness)}}{\text{Minimum luminance of five points (brightness)}}$$




## 10. Packing for shipping

### 10.1. Packing form

**Type A**

a) Open Cell quantity in 1 cell box : 18 cells
b) Piling number of cell box : 4 Maximum
c) 1 palette size : 1600(W) x 1000(D) x 889(H) [mm]
d) Total mass of 1 palette filled with full open cells : 380kg Maximum

**Type B**

e) Open Cell quantity in 1 cell box : 20 cells
f) Piling number of cell box : 4 Maximum
g) 1 palette size : 1600(W) x 1000(D) x 889(H) [mm]
h) Total mass of 1 palette filled with full open cells : 420kg Maximum

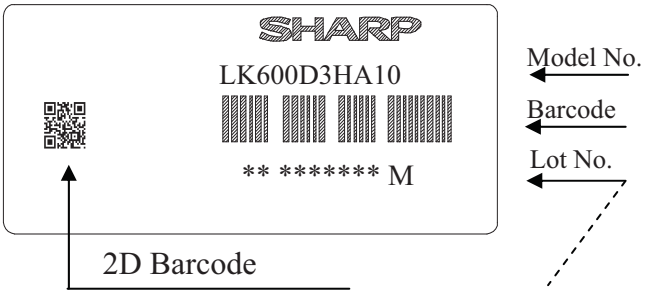
### 10.2. Label

a) Cell label

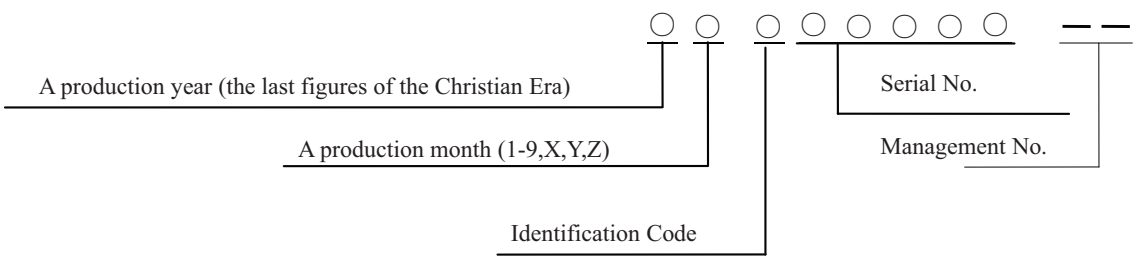
This label is stuck on the protection film of front polarizer. (Please trace the Cell lot number after the film is peeled off.)

Cell label : LK600D3HA10 or LK600D3HA10M [Japan production]

ex) [LK600D3HA10M]




How to express Lot No.

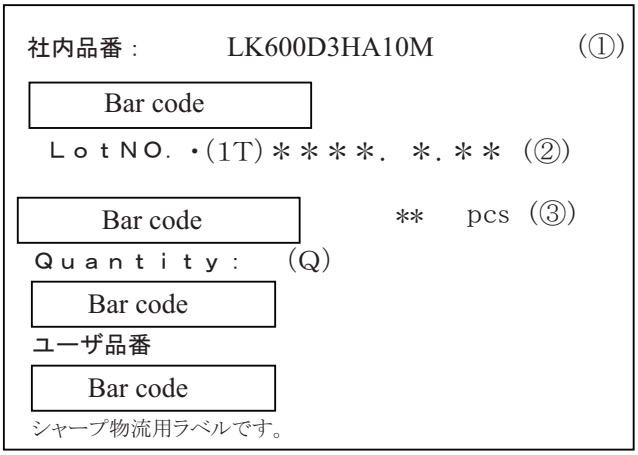


b) Packing Label

This label is stuck on the packing case (cell box) and carton.

Packing Label:LK600D3HA10 or LK600D3HA10M [Japan production]

Ex) [LK600D3HA10M]




① Management No.

② Lot No. (Date)

③ Quantity

## 11. Reliability test item

| No. | Test item (Test sample form) | Condition |
|---|---|---|
| 1 | High temperature storage test | Ta=60°C 240h |
| 2 | Low temperature storage test | Ta=-25°C 240h |
| 3 | High temperature and high humidity operation test | Ta = 40°C ; 95%RH 240h (No condensation) |
| 4 | High temperature operation test | Ta = 50°C 240h |
| 5 | Low temperature operation test | Ta = 0°C 240h |
| 6 | Vibration test (Cell Box with full Open Cells) | X and Y direction: 15min, Z direction: 60min. 5Hz to 50Hz acceleration velocity: 1.0G Sweeping ratio: 3min |
| 7 | Drop test (Cell Box with full Open Cells) | Height: 25cm (corner and edge), 32cm (surface) Number: 8times (corner 1time and edge 3times and surface 4times) |

Above tests are executed under the CCFL module conditions.

## 12. Precautions

a) Be sure to turn off the power supply when inserting or disconnecting the cable.

b) Be sure to design the module and cabinet so that the Open Cell can be installed without any extra stress such as warp or twist.

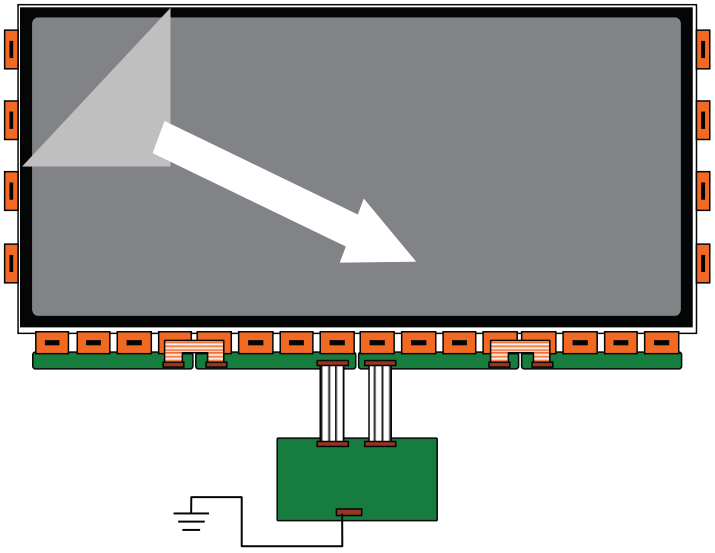
c) Since the polarizer is easily damaged, pay attention not to scratch it.

d) Since long contact with water may cause discoloration or spots, wipe off water drop immediately.

e) When the polarizer is soiled, wipe it with absorbent cotton or other soft cloth.

f) Since the panel is made of glass, it may break or crack if dropped or bumped on hard surface. Handle with care.

g) Precautions of peeling off the protection film.



- Be sure to peel off slowly (recommended more than 15sec) and constant speed.
- Peeling direction shows Fig.
- Be sure to ground person with adequate methods such as the anti-static wrist band.
- Be sure to ground S-PWB while peeling of the protection film.
- Ionized air should be blown over during peeling action.
- The protection film must not touch drivers and S-PWBs.
- If adhesive may remain on the polarizer after the protection film peeling off, please remove with isopropyl-alcohol.

h) Since the Open Cell consists of TFT and electronic circuits with CMOS-ICs, which are very weak to electrostatic discharges, persons who are handling the Open Cell should be grounded through adequate methods such as the anti-static wrist band. Connector pins should not be touched directly with bare hands.

- Reference : Process control standard of sharp

| | Item | Management standard value and performance standard |
|---|---|---|
| 1 | Anti-static mat (shelf) | 1 to 50 [M ohm] |
| 2 | Anti-static mat (floor, desk) | 1 to 100 [M ohm] |
| 3 | Ionizer | Attenuate from ±1000V to ±100V within 2 sec |
| 4 | Anti-static wrist band | 0.8 to 10 [M ohm] |
| 5 | Anti-static wrist band entry and ground resistance | Below 1000 [ohm] |
| 6 | Temperature | 22 to 26 [°C] |
| 7 | Humidity | 60 to 70 [%RH] |

i) The Open Cell has some PWBs, take care to keep them from any stress or pressure when handling or installing the Open Cell, otherwise some of electronic parts on the PWBs may be damaged.

j) When handling the Open Cell and assembling them into module and cabinets, please be noted that long-term storage in the environment of oxidization or deoxidization gas and the use of such materials as reagent, solvent, adhesive, resin, etc. which generate these gasses, may cause corrosion and discoloration of the Open Cell.

k) Applying too much force and stress to PWB and driver (COF) may cause a malfunction electrically and mechanically.

l) The Open Cell has high frequency circuits. Sufficient suppression to EMI should be done by system manufacturers.

m) Please be careful since image retention may occur when a fixed pattern is displayed for a long time.

n) The chemical compound, which causes the destruction of ozone layer, is not used.

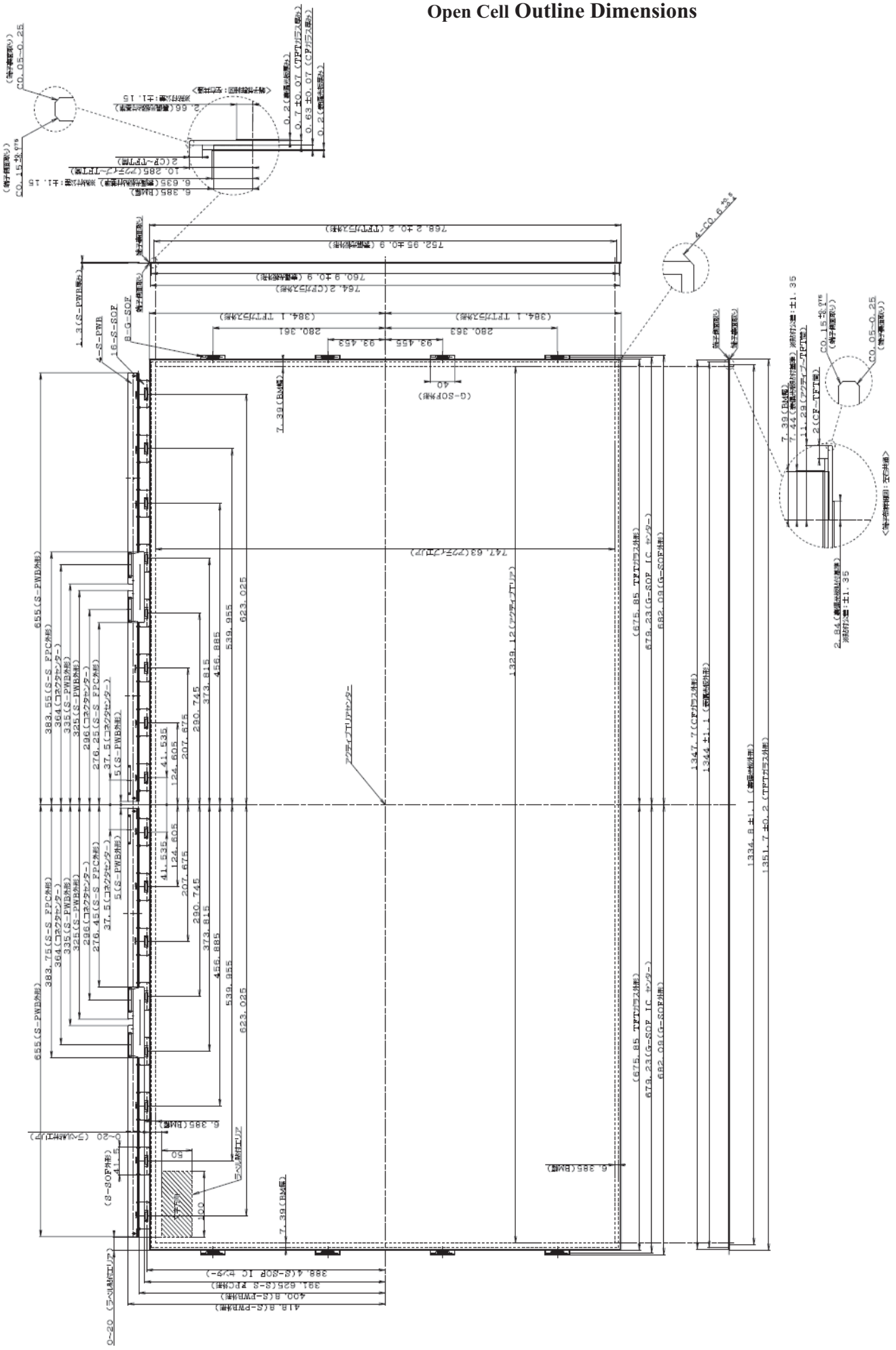
o) This Open Cell is corresponded to RoHS. "R.C." label on the side of palette shows it.

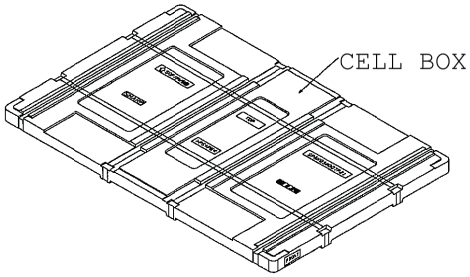
p) When any question or issue occurs, it shall be solved by mutual discussion.

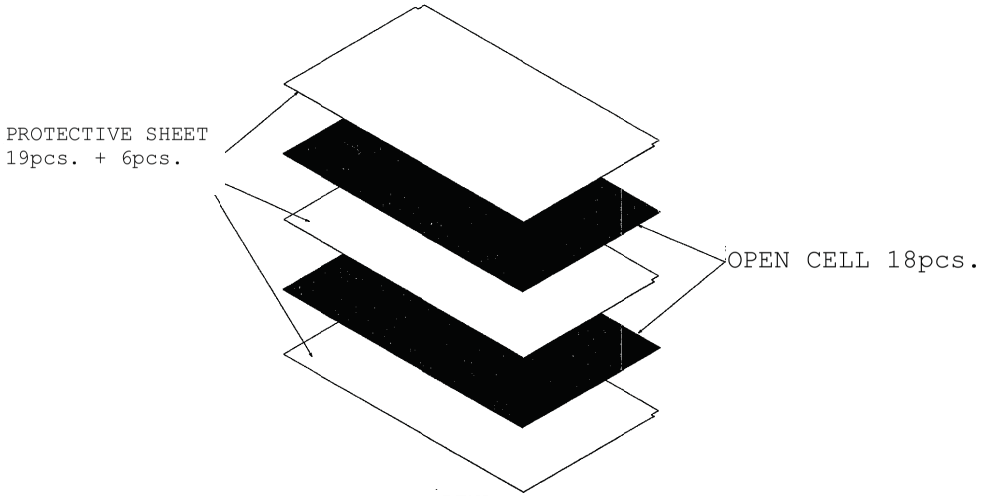
## 13. Cell Box condition

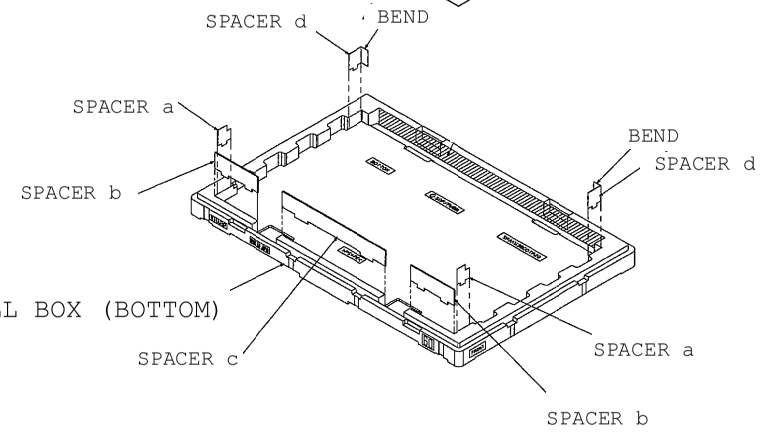
| | |
|---|---|
| Temperature | 0°C to 40°C |
| Humidity | 95% RH or less |
| Reference condition | 20°C to 35°C, 85% RH or less (summer)<br>5°C to 15°C, 85% RH or less (winter)<br>the total storage time (40°C, 95% RH) : 240h or less |
| Sunlight | Be sure to shelter a production from the direct sunlight. |
| Atmosphere | Harmful gas, such as acid and alkali which bites electronic components and/or wires must not be detected. |
| Notes | Be sure to put cartons on palette or base, don't put it on floor, and store them with removing from wall.<br>Please take care of ventilation in storehouse and around cartons, and control changing temperature is within limits of natural environment. |
| Storage life | 1 year. |

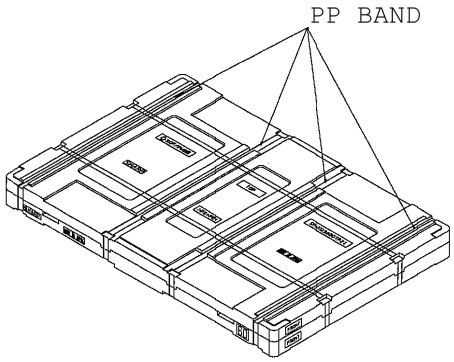
# Open Cell Outline Dimensions

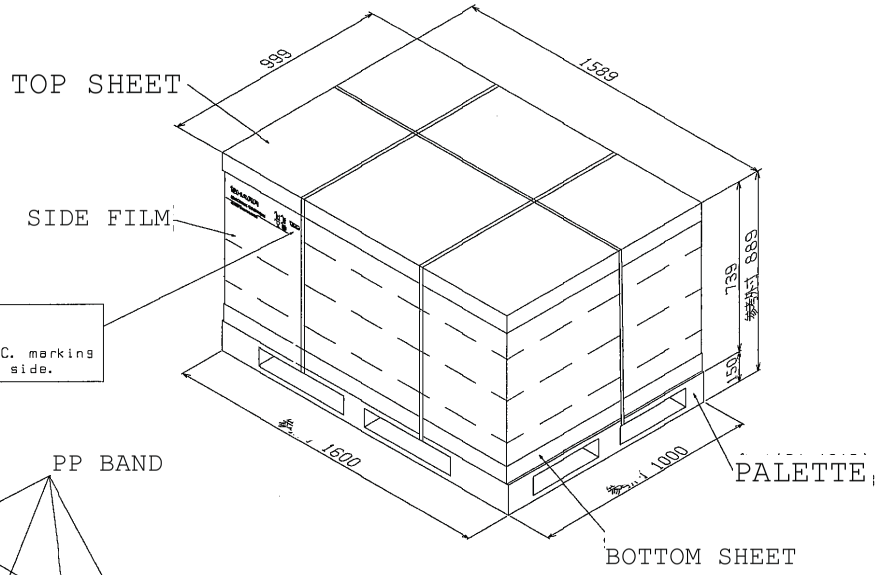




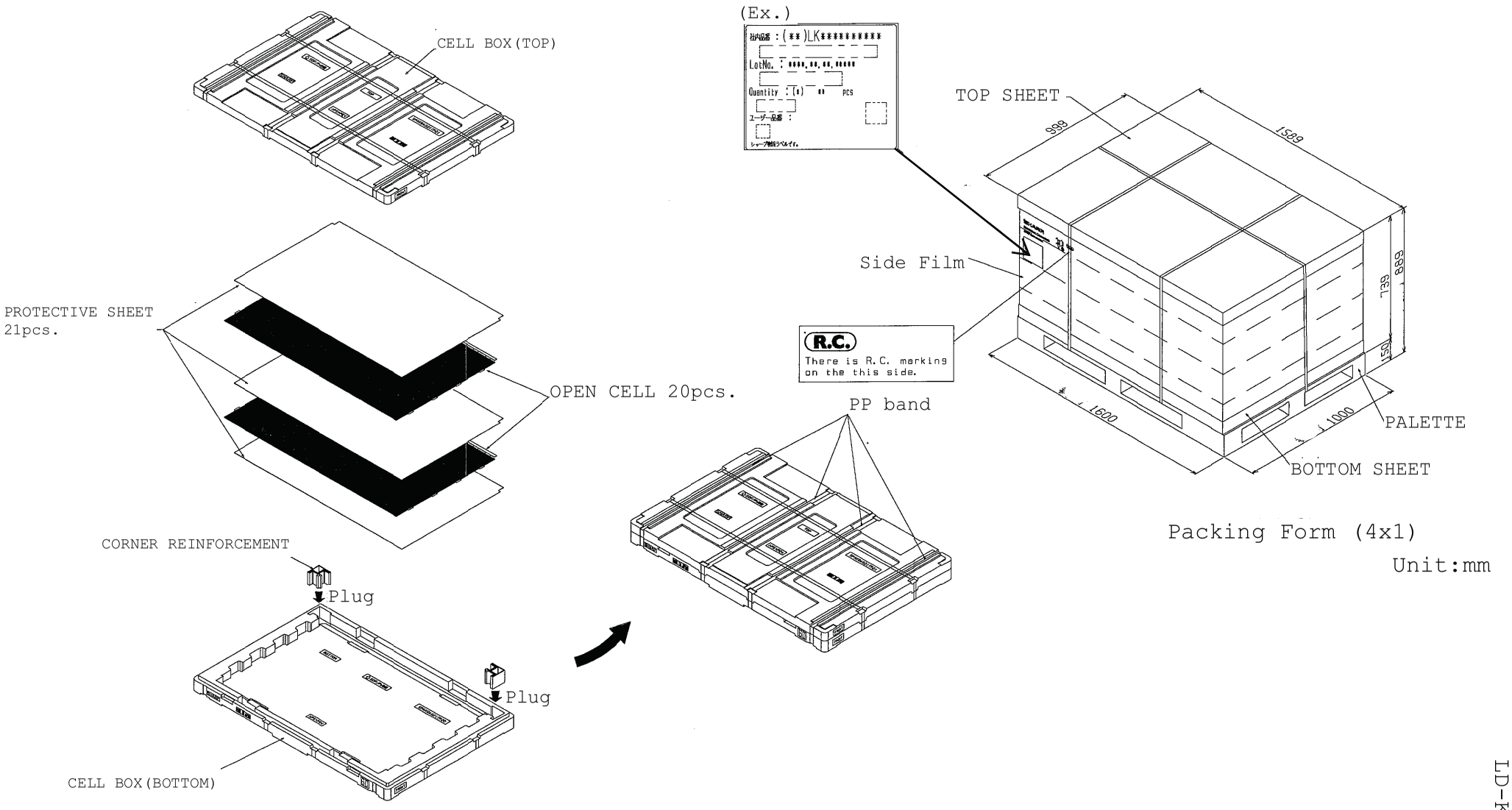




Packing Form (4x1)

# Packing form:Type A




Packing Form (4x1)

Unit:mm

# Packing form:Type B

LD-K23628-22